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(54) **Thermal power plant arrangement**

(57) Provided is a thermal plant with a reheat heat boiler (10) and a water/steam cycle comprising a pressure series of steam turbines (20,30,40). A bypass line (14) connects the high pressure turbine outlet (24) to one of a selection of the intermediate pressure steam turbine

outlet (34), the low pressure steam turbine inlet (42) and a point fluidly between the medium pressure steam turbine outlet (34) and the low pressure steam turbine inlet (42) and further bypasses the intermediate pressure turbine (30) and the reheater (12).

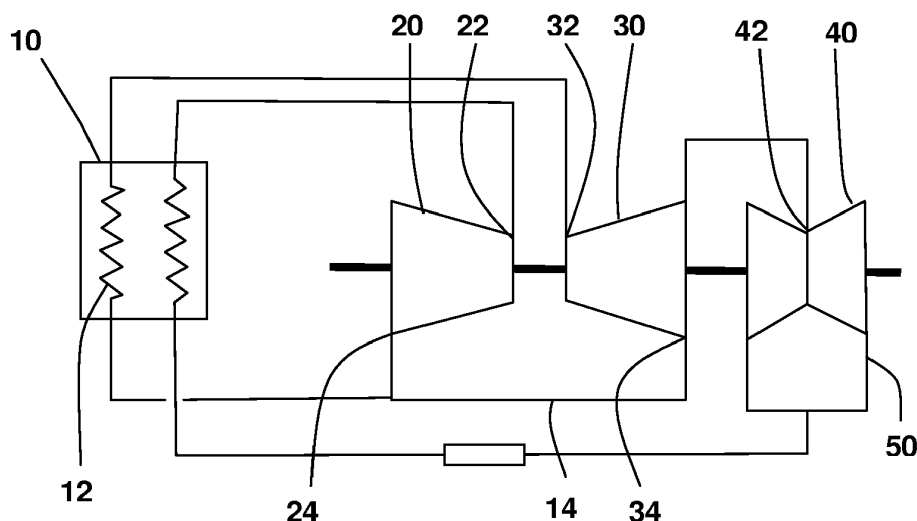


FIG. 1

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Description

TECHNICAL FIELD

[0001] The present disclosure relates generally to thermal power plant configurations and more specifically to arrangements for start-up and low load operation of steam turbines of such plants.

BACKGROUND INFORMATION

[0002] A commonly used thermal power plant comprises a steam system in which steam that is generated in a boiler passed through a steam regulating valve, a high pressure turbine, a reheater and an intercept valve and then into an intermediate pressure turbine and finally into a low pressure turbine.

[0003] In such a configuration, the first turbine, which is commonly referred to as the high pressure turbine is a so called back pressure turbine. During start-up or during low load operation such high pressure turbines may suffer windage.

[0004] US patent no 4744723 describes a start-up solution that involves the following steps. Upon starting the thermal power plant, the steam generated in the boiler is delivered through a high pressure bypass system that bypasses the steam regulating valve and the high pressure turbine directly into the intermediate and the low pressure turbines so as to accelerate these turbines. During this intermediate pressure stage a passage is used to connect the steam condenser and the high pressure turbine to each other so that an interior of the high pressure turbine can be kept under a vacuum condition. After synchronous steam supply the steam is then preferentially provided to the high pressure turbine via through the steam regulating valve instead of the high pressure bypass system.

SUMMARY

[0005] A steam turbine plant arrangement is disclosed that is intended to provide a means of enabling the control of the wetness of steam at the last stage blade row of a low pressure steam.

[0006] It attempts to address this problem by means of the subject matter of the independent claims. Advantageous embodiments are given in the dependent claims.

[0007] The disclosure is based on the general idea of providing a bypass line connecting the exhaust of the high pressure turbine with the exhaust of the intermediate pressure steam turbine.

[0008] According to an exemplary embodiment there is provided a thermal power patent comprising a boiler with a reheater and a pressure series of steam turbines. The series of steam turbines includes a high pressure turbine having a high pressure turbine inlet connected to the boiler and a high pressure turbine outlet, an intermediate pressure turbine having an intermediate pressure

turbine inlet connected to the high pressure turbine outlet via the reheater and an intermediate pressure turbine outlet, and a low pressure turbine with a low pressure turbine inlet connected to the medium pressure turbine outlet via the reheater. The thermal power plant further includes a bypass line that fluidly connects the high pressure turbine outlet to one of a selection of the high pressure steam turbine outlet, the low pressure steam turbine inlet and a point fluidly between the medium pressure steam turbine outlet and the low pressure steam turbine inlet, while bypassing the intermediate pressure turbine and the reheater.

[0009] Especially during start-up conditions, as a result of windage of the high pressure turbine caused by increased backpressure, exhausted steam of the high pressure turbine may have a higher enthalpy than the steam at the inlet of the low pressure turbine. By mixing the high pressure exhaust steam with intermediate pressure exhaust steam, as enabled by aspects of the invention, the enthalpy of the steam at the inlet of the low pressure turbine is improved, thus reducing the wetness and making it possible to extract power from the high pressure exhaust steam.

[0010] In addition, during start-up, the inlet temperature and pressure of the hot re-heat may be such that steam entropy-enthalpy falls below the expansion line at base load. If this occurs, the wetness of the steam at the last stage guiding blades may be too high and thus lead to serious droplet erosion during start-up. By admitting steam from the exhaust of the high pressure turbine the enthalpy of the steam may be increased thus avoiding the problem.

[0011] It is a further object of the invention to overcome or at least ameliorate the disadvantages and shortcomings of the prior art or provide a useful alternative.

[0012] Other aspects and advantages of the present disclosure will become apparent from the following description, taken in connection with the accompanying drawing which by way of example illustrates an exemplary embodiment of the present invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013] By way of example, an embodiment of the present disclosure is described more fully hereinafter with reference to the accompanying drawing, in which:

Figure 1 is a schematic of a steam power plant comprising an exemplary embodiment.

DETAILED DESCRIPTION

[0014] An exemplary embodiment of the present disclosure is now described with references to the drawing, wherein like reference numerals are used to refer to like elements throughout. In the following description, for purposes of explanation, numerous specific details are set forth to provide a thorough understanding of the disclo-

sure. However, the present disclosure may be practiced without these specific details, and is not limited to the exemplary embodiment disclosed herein.

[0015] In an exemplary embodiment shown in Fig. 1, a thermal power plant comprises a boiler 10 with a reheater 12. Steam from the boiler 10 is feed into a high pressure turbine 20 via a high pressure turbine inlet 22 where it is expanded and work extracted. Steam exhausted from the high pressure turbine outlet 24 then passes through the reheater 12 before being fed into an intermediate pressure turbine 30 via an intermediate pressure turbine inlet 32. After expansion and extracting work in the intermediate pressure turbine 30, steam is exhausted via an intermediate turbine outlet 34 from where it is fed into a low pressure turbine inlet 42 of a low pressure turbine 40. Exhaust from the low pressure turbine 40 is then condensed in a condenser 50 before being fed back to the boiler 10 where it is boiled and fed back to the high pressure turbine 20.

[0016] In an exemplary embodiment shown in Fig. 1, the thermal plant further includes a bypass line 14 that connects the high pressure turbine outlet 24 with the low pressure turbine inlet 42 while bypassing the reheater 12 and the intermediate pressure turbine 30. In different exemplary embodiments the bypass line 14 is connected to the intermediate pressure turbine outlet 34, the low pressure turbine inlet 42 or a point fluidly between the intermediate pressure turbine out 34 and the low pressure turbine inlet 42.

[0017] Although the disclosure has been herein shown and described in what is conceived to be the most practical exemplary embodiment, the present disclosure can be embodied in other specific. The presently disclosed embodiments are therefore considered in all respects to be illustrative and not restricted. The scope of the disclosure is indicated by the appended claims rather than the foregoing description and all changes that come within the meaning and range and equivalences thereof are intended to be embraced therein.

REFERENCE NUMBERS

[0018]

10	Boiler	45
12	Reheater	
14	Bypass	
20	High pressure turbine	
22	High pressure turbine inlet	
24	High pressure turbine outlet	50
30	Intermediate pressure turbine	
32	Intermediate pressure inlet	
34	Intermediate pressure outlet	
40	Low pressure turbine	
42	Low pressure turbine inlet	55
50	Condensor	

Claims

1. A thermal power plant comprising:

a boiler (10) with a reheater (12)
a high pressure turbine (20) with:

a high pressure turbine inlet (22) connected to the boiler (10); and
a high pressure turbine outlet (24),

an intermediate pressure turbine (30) with:

an intermediate pressure turbine inlet (32) connected to the high pressure turbine outlet (24) via the reheater (12); and
an intermediate pressure turbine outlet (34),

a low pressure turbine (40) with a low pressure turbine inlet (42) connected to the medium pressure turbine outlet (34),

characterised by a bypass line (14) that: fluidly connects the high pressure turbine outlet (24) to one of a selection of the intermediate pressure steam turbine outlet (34), the low pressure steam turbine inlet (42) and a point fluidly between the medium pressure steam turbine outlet (34) and, the low pressure steam turbine inlet (42); and
bypasses the intermediate pressure turbine (30) and the reheater (12).

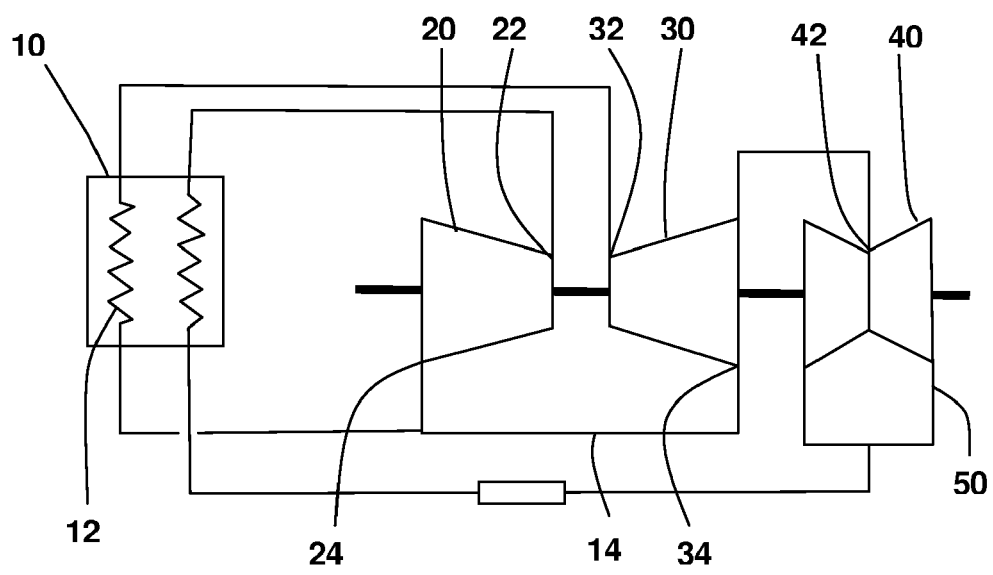


FIG. 1



EUROPEAN SEARCH REPORT

Application Number
EP 14 17 5289

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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	EP 0 939 200 A1 (MITSUBISHI HEAVY IND LTD [JP]) 1 September 1999 (1999-09-01) * paragraphs [0014], [0015], [0030]; figure 1 *	1	INV. F01K7/24
X	JP H09 256815 A (TOSHIBA CORP) 30 September 1997 (1997-09-30) * figure 1 *	1	
A	US 4 873 827 A (HADANO YOSHIKAZU [JP] ET AL) 17 October 1989 (1989-10-17) * figure 3 *	1	
A	DE 102 27 709 A1 (ALSTOM SWITZERLAND LTD [CH] ALSTOM TECHNOLOGY LTD [CH]) 27 February 2003 (2003-02-27) * figure 2 *	1	
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The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (IPC)
			F01K
Place of search		Date of completion of the search	Examiner
Munich		25 September 2014	Coquau, Stéphane
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
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25-09-2014

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This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

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